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6. AUTHOR(S)

Dennis G. Hall

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES)

The Institute of Optics
University of Rochester
Rochester, NY 14627

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13. ABSTRACT *(Maximum 200 words)*

This project purchased a diode-pumped, mode-locked Ti:Sapphire short-pulse laser system that would produce ultrashort pulses in the 800 nm wavelength range. Acquiring the laser makes it possible to investigate the interaction between molecular or nanoparticle resonances and the propagating electromagnetic surface modes (i.e., surface waves) supported by nearby planar thin-film structures. Investigations in the linear optical regime have already demonstrated that this interaction produces surprisingly strong linear optical effects. Acquiring the requested short-pulse laser system enables the existing ARO-sponsored research program focused on linear effects to be extended to include the nonlinear regime.

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Final Report for DAAD19-99-1-0022 (DURIP):

Sub-Picosecond Laser for Investigating Oscillator-Waveguide Interactions

The Problem Under Study

The contract/grant mentioned above was awarded by the U.S. Army Research Office (ARO) under the FY99 Defense University Research Instrumentation Program (DURIP). The original proposal requested funding to purchase a diode-pumped Ti:Sapphire short-pulse laser system that would produce ultrashort pulses in the 800 nm wavelength range. Our goal was, and remains, to use that laser to investigate, in the nonlinear optical regime, the interaction between molecular or nanoparticle resonances and the propagating surface modes of nearby planar thin-film structures. Investigations in the linear optical regime had already demonstrated that this interaction produces surprisingly strong optical effects, including a 400× enhancement in the intensity of the signal detected from a layer of fluorescing molecules deposited onto a metal-clad waveguide and a more than 20× enhancement in the photocurrent in a thin silicon-on-insulator photodetector. Acquiring the requested short-pulse laser system was intended to enable the existing ARO-sponsored research program that focused on linear effects to be extended to include the nonlinear regime.

The System Purchased

The original proposal suggested purchasing such a laser system from the Coherent Laser Group in Santa Clara, CA. However, after ARO agreed to fund the proposal, subsequent conversations with members of the Ti:Sapphire-laser user community and with the vendors led us to choose instead to purchase the laser system from Spectra-Physics (Mountain View, CA). Specifically, we purchased a 5-Watt Millennia-pumped Tsunami regeneratively mode-locked Ti:Sapphire laser system from Spectra-Physics. The selection, purchase and delivery of the system took just over six months, with the laser system being delivered to the University of Rochester during September 1999. Shortly thereafter, Spectra-Physics field representatives came to the university and installed the system. After a small number of new-system "glitches," the system became stable and (so far) reliable. Graduate student Kai LaFortune is currently using the system to probe for enhanced optical nonlinearities in sample systems composed of noble-metal nanoparticles and thin layers of metal, as discussed in the original proposal. The research has not yet produced publications, but we are confident that will happen very soon.

List of Manuscripts

No papers were published during the period 3/1/99 – 2/29/00 that described research that made use of the laser purchased using this award.

Scientific Personnel

(a) Dennis G. Hall, William F. May Professor, The Institute of Optics, University of Rochester;
(b) Kai LaFortune (B.S., Physics, Bates College), Ph.D. candidate in The Institute of Optics, University of Rochester. Mr. LaFortune is presently supported by an AASERT grant through the U.S. Army Research Office.

Inventions

No invention disclosures were filed during this reporting period.

Results

Because the grant/contract was an award for purchasing instrumentation, the major result is that the proposed mode-locked Ti:Sapphire laser system was indeed ordered, purchased, received, and made operational. The laser system has been incorporated into our ongoing research on oscillator-waveguide interactions, as proposed, and laboratory investigations that make use of that laser are in progress.